VOORBURG GROUP ON SERVICE STATISTICS

Ninth Meeting

Sydney, 17-21 October 1994

MEASURING THE LEVEL OF EDUCATION BY THE ELP-INDICATOR IN COMPUTER AND TECHNICAL SERVICES

Preliminary results

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MEASURING THE LEVEL OF EDUCATION BY THE ELP-INDICATOR IN COMPUTER AND TECHNICAL SERVICES - PRELIMINARY RESULTS

1. Introduction

1.1 Background

One of the major problems of today, and undoubtedly are of great interest in the future, is comparing the qualifications of the personnel working in different industries. The importance of the two traditional production factors, labour and capital, differ significantly from one industry to another. A common situation is that the stock and accumulation of physical capital is recorded in detail. However, we can only capture data on employment to a very limited extent, often only the number of employees. Therefore the qualitative data on employees as human capital is largely neglected in the official statistics. The current situation thus seems to be far from satisfactory.

The educational structure of employees in business services is assumed to have an impact on the enterprises' economic state and competitiveness in the market. For instance, Nordic experience has shown, that the value added per employee figures tend to be high in professional business services even if the fixed capital used in the production process is low compared with e.g. manufacturing industries. The standard formula of enterprises' accounts is thus clearly inadequate in yielding information on human capital.

It should be of common interest to be able to recognize the industries with growth potential. These items have earlier been recognized in other fora, such as the OECD Conference on Technology and Innovation Policy and Employment[1], where practical problems concerning the information on human capital were specified. Capital acquisition problems might arise from the inadequate records of human capital as "Some high tech firms such as software companies often appear under-capitalised and accordingly have difficulties in raising bank loans. But this is simply because human capital is not treated as an assent in accounting standards and practices. If human capital were treated in the same way as physical capital, the financing of small high tech firms would be facilitated".

The objective of this paper is to take a step forwards in measuring human capital by the educational attainment of personnel. To this end the Educational Level of Population indicator (ELP-indicator) is introduced. Obviously this approach is a simplification of reality, but as will be shown later on, we are able to represent some rather interesting results

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1 Peter Swanse: OECD Unemployment : Some Policy Options, Helsinki October 1993, p.17.

1.2. Introducing the ELP-indicator

In the early 1990s Education Statistics of Statistics Finland developed a tool known as the ELP-indicator to measure the educational level of the population. Basically the ELP-indicator is very simple, assuming equal differences between the educational classes, i.e. average educational attainments can be calculated from the data. This permits comparison of the educational level of various sectors of the population and in it by region. The advantage of the indicator is that educational levels can be compared between different groups, such as sex and age, with a single figure.

The indicator is calculated according to a person's highest qualification using the level code for education. The higher the figure of the three digit indicator, the higher the level of education is. The criterion behind the Finnish Educational Classification is the number of schooling years: The longer the education is, the higher the code for the educational level is. The ELP-indicator has been tested at Statistics Finland with rather encouraging results.

The Educational Level of Population (ELP) indicator is calculated as follows:

$$ELP = \sum_{i=1.5}^{8} f_i x_i \; / \; \sum_{i=1.5}^{8} f_i * 100$$

ELP = educational level of population
f_i = number of persons
x_i = level code of the Finnish Standard Classification of Education
- 1.5 = primary or lower secondary
- 3 = lower level of upper secondary
- 4 = upper level of upper secondary
- 5 = lowest level of tertiary education
- 6 = lower degree level of tertiary education
- 7 = higher degree level of tertiary education
- 8 = doctorate or equivalent level of tertiary education

In this paper we have extended the model by integrating some enterprise data to classify the educational data according to the employment size class and location of the employer enterprise.

1.3 Database and linking methodology

Computer and technical services were chosen for our exercise for two reasons. Firstly, the importance of well educated personnel is widely recognized in these services, and secondly, these sectors appear to be the two largest ones within the business services sector in Finland.

For the study, three different databases were created for both the sectors. The statistical unit used in the databases for the Financial Statement Statistics (FSS) and the Business Register (BR) is the enterprise (legal unit). The Business Register is also the donor register for the sampling universe of the FSS survey. In the database for the Regional Employment

Statistics the individual is used as the statistical unit. Each of the individuals can be linked directly to an employer firm. Using the individual as a statistical unit has great potential for hierarchical stratification of the data. The statistical year of the study is 1991. Unfortunately, at this early stage it was not possible to generate any time series data. It is also pointed out that the data analyzed in this paper refers to the FSS enterprise population and therefore to the persons employed in these enterprises, *not* to the total level of industries. In principle, it is possible to use the files of the National Board of Taxation in order to cover the complete field of enterprise accounts of the selected activities. This would, however, call for extensive data processing. For further information on the population studied and methods, see annex I.

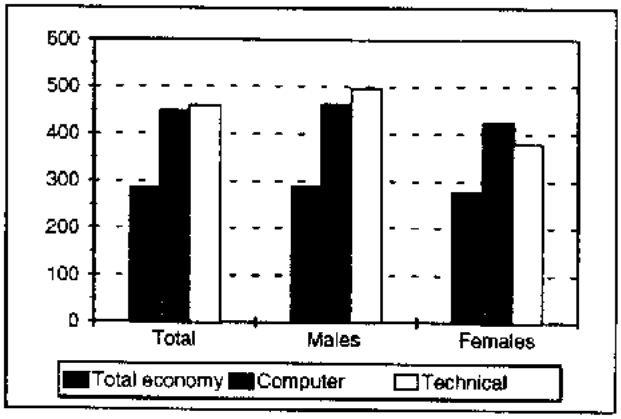
In chapters 2 and 3 the differences in educational attainment are studied according to the ELP-indicator. Firstly, in chapter 2 the differences by sex and age of the employed are presented. In chapter 3 the ELP-indicator is calculated according to enterprises' demography as the employment size class of the enterprise and location. The potential for further analysis is also discussed. Concluding remarks are given in chapter 4.

2. The ELP-indicator by sex and age of employed

2.1 The ELP-indicator by sex

The average record of the ELP- indicator for the total population of Finland aged 20 and over was 283. Both for computer and technical activities the ELP-indicator shows records about 60 per cent higher, being 461 for technical activities and 448 for computer activities. Note also that the gap between male and female educational attainment is clearly larger in technical activities (105 points) than in computer activities (40 points). For the total population, the level of education shows almost equal records for males (287) and for females (279).

Figure 1 : The ELP-indicator by sex



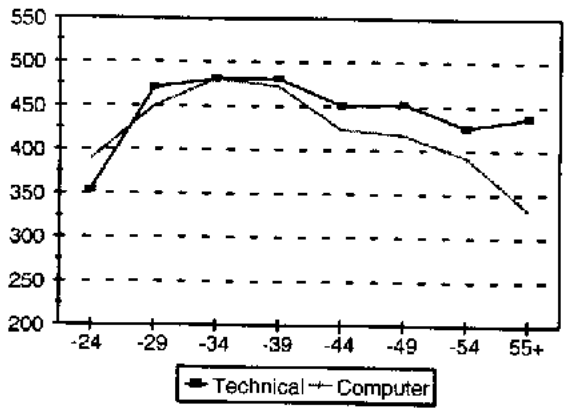
Source: Statistics Finland

2.2 The ELP-indicator by age

It should be pointed out that the number of persons included in each of the age groups differs significantly. The frequencies of each age group are presented in annex II. In general, the personnel aged under 25 and over 50 are of less importance than the other age groups. In addition, a larger proportion of female than male workers belong to the under 30 age groups. Furthermore, the importance of older workers tends to be higher in the technical services studied than in computer services.

The study of the ELP indicator by 5-year age groups of personnel shows that technical services have a higher record in all age groups except the under 25 years. For personnel aged 30-34 the indicator is equal, but for older groups technical services clearly have a higher level of education. In both the activities studied, the educational attainment of the personnel appears to be highest in the age groups '25-39', after which it decreases.

Figure 2: ELP-indicator by age group and activity



Source: Statistics Finland

Male workers in technical services in each over 25 age group tend to have a higher educational attainment than those in computer services. Female workers in computer services have a higher education in all the age groups, excluding 55+, than female workers in technical services. It is also interesting that the level of education of females clearly falls more rapidly in the 35+ age groups than that of males. This might indicate that the older females engaged in these services are more often doing office work.

Figure 3a: ELP-indicator for males by age group and activity

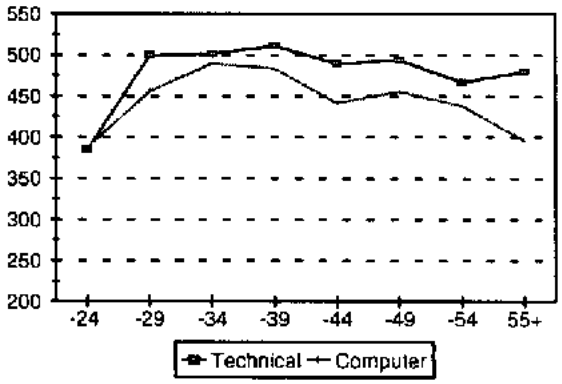
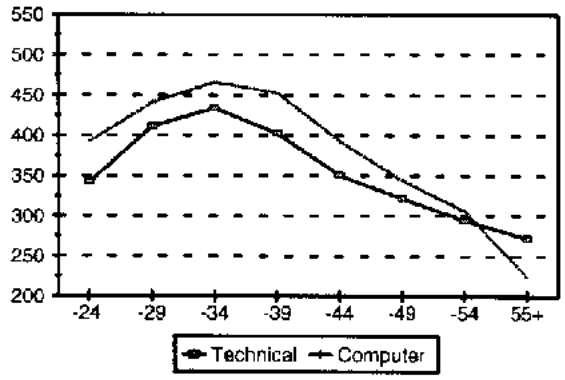


Figure 3b: ELP-indicator for females by age group and activity



Source: Statistics Finland

To conclude: the educational differences by sex are clearly larger in technical than in computer services. This might be an implication of choice of career. Maybe females are in general more willing and ready to become computer expert or the like than to study the more male dominated engineering sciences.

It can also be seen that the younger generation of under 35 years is well educated compared with the older age groups. This is particularly true of females. While female workers tend to have a higher education in computer than in technical services, the opposite is true of males.

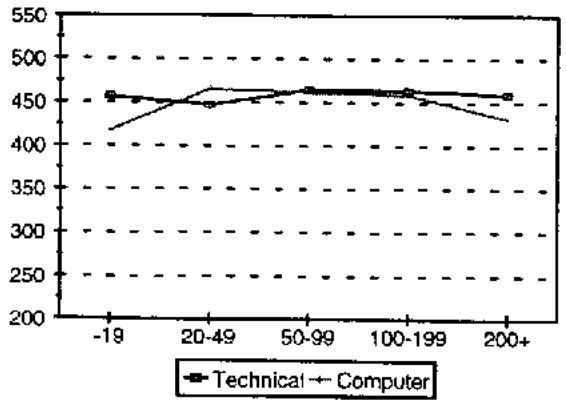
3. The ELP-indicator by employer enterprise demography

3.1 Employment size class

The problem with the micro-enterprise data is, that since the FSS is a set of survey based statistics, there are only a few micro enterprises with a low number of employed persons. The smallest size class studied is enterprises employing fewer than 20 persons. Larger enterprises are broken down into groups of 20-49, 50-99, 100-199 and 200+ persons employed. It should be pointed out that the number of enterprises included in some of the groups is

low. The frequencies of enterprises and persons employed in each group are presented in annex II.

Figure 4: ELP-indicator by enterprises' employment size class and activity



Source: Statistics Finland

The level of education in technical services tends to be more constant across the different size classes than in computer services. Computer services show a somewhat lower level of education in small and large enterprises. However, the level of education is almost equal in enterprises of 20-199 employees. In employment size class 20-49 technical services record a lower level of education than computer services.

3.2 Regional distribution

The enterprises are in the following classified according to the metropolitan region (Helsinki) and other regions of Finland. The classification is according to the home municipality of the enterprise. However, these enterprises might have local units operating in other regions as well. The frequencies of the regional breakdown are presented in annex III.

Table 1: ELP-indicator by sex, region and activity

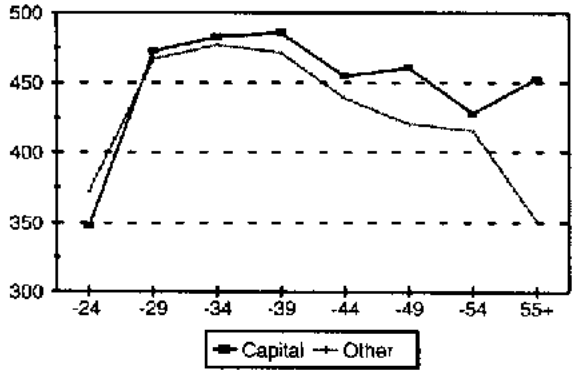
	Technical	Computer
Metropolitan	463	446
males	500	463
females	383	421
Other	453	453
males	483	463
females	370	433

Source: Statistics Finland

Taking into account the regional dimension of the enterprises does not seem to have much influence on the level of education. The educational level of those employed in technical services is somewhat higher in Helsinki region than in other parts of Finland. This is true for both male

and female workers. In computer services the records for the Helsinki region are somewhat lower than for other regions. However, for males the records are equal between the regions. Consequently, female workers outside the Helsinki region tend to have a higher level of education. This might implicate that computer services of a routine type are produced in the Helsinki region. Note also (cf. annex III) that the personnel of the computer and technical services enterprises studied is clearly concentrated on the metropolitan area.

Figure 5a: ELP-indicator of technical services by personnel age and region

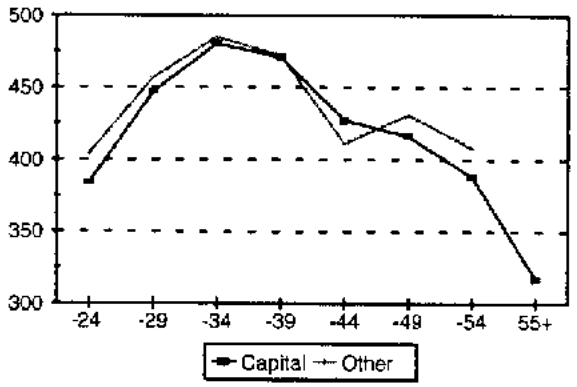


Source: Statistics Finland

Excluding the under 25 age group, the ELP is higher in the Helsinki region than other regions of Finland in all the personnel age classes of technical services [2].

Computer services seem to behave differently, since the records of ELP show a lower educational level for those employed in metropolitan district enterprises. This seems to be true of all the age categories, except the 39-44 age group.

Figure 5b: ELP-indicator of computer services by personnel age and region



Source: Statistics Finland

[2]Note that for both activities there are not many observations in age group '55+'.

The study will be extended to accounting data later on. The correlations on individual level between earned salaries and education in both activities were briefly studied. Not surprisingly, there tends to be a positive and significant correlation between these variables. In general, the correlation of education and salaries seems to be higher for females than for males.

Another interesting approach would be to study the employment qualifications by enterprises' age classes derived from Business Register. This is not, however, carried out here.

4. Concluding remarks

The primary aim of this paper was to introduce the Educational Level of Population as ELP-indicator, which can be used for analyzing differences in educational attainment between groups. The ELP for technical and computer services was studied by age groups and sex for selected enterprises.

The level of education in the studied technical and computer services enterprises in 1991 appeared to be about 60 percent higher than that of the total population of Finland clearly emphasizing the demand for highly educated personnel in these services. We also found that the differences in the level of education by sex are clearly larger in technical than in computer services. The male workers in technical services tend to have a higher level of education than their counterparts in computer services. However, the opposite seems to be true of female workers. The educational level of males seems to be rather constant across the age groups, while the level of education of females decreases rather steeply as the age increases. In addition, both males and particularly females tend to have the highest records of ELP in the age groups 25-39.

Our second objective was to illustrate the possibilities of integrating enterprise data in the study. In this context the enterprises' employment size class and regional breakdown were briefly analyzed. The behaviour of the ELP by enterprises' employment size and location in the Helsinki region or outside differ somewhat by activity.

The level of education tends to be more constant across the enterprises' size classes in technical services than in computer services. Technical services tend to have a higher proportion of highly educated personnel in the Helsinki region while the opposite is true of computer services. However, the recorded differences by enterprises' size class and location remained rather modest.

Science and Technology Statistics at Statistics Finland collects annual data on research and development expenses in computer and technical activities. In 1991 and 1993 the sample base equalled that of Financial Statement Statistics, which facilitates the identification of the R&D intensive respondent enterprises within these sectors. This data could also be integrated into the study.

Our intention is to further analyze the accounting data, and possibly take into account the years 1990 and 1992. The study could also be further extended to other activities, such as management consulting, legal and advertising. The theoretical aspects and framework also need more profound discussion and development.

Furthermore, there is potential for using more sophisticated methods such as variance analysis or regression analysis to find the key relations between enterprises and employees and to test the significance of these differences and relations.

ANNEX I

Description of the data sources

This report is best characterised as an exercise to study the possibilities of linking the enterprise data from different sources using the enterprise's identification code as a link between the Regional Employment Statistics and the Business Statistics. We can thus analyze the *micro level* enterprise data including a wide range of variables from the economic state of the enterprise to the structure and qualifications of the personnel.

To this end Statistics Finland has compiled a data set at enterprise level for two 'pilot' business services sectors, computer and technical services, which closely follow the classification of *ISIC Rev. 3* of 72 Computer and related activities and 7420 Architectural and engineering activities and related technical consultancy. This is done by exhausting the existing data sources of the Financial Statement Statistics and the Business Register. Additional data on individual qualifications has been generated from the Regional Employment Statistics. The statistical year of the study is 1991.

The starting point for the study was the survey-based Financial Statement Statistics of 1991[1]. The sample was selected by stratified sampling, which automatically chooses the large enterprises and a sample of the small ones. All enterprises with more than 50 employees were included from both the sectors examined. The response rates in both sectors for 1991 exceeded 94 per cent.

In order to keep the data quality as good as possible, the data was controlled in two steps. Firstly, due to mismatches and some inconsistencies between the basic variables from the three different sources, some of the enterprises were excluded. In the second step, some elementary economic variables and ratios of the enterprises were used as criteria to raise the data homogenity. Consequently, the original data for technical services was reduced from 165 to 142 enterprises and the data for computer services from 95 to 80 enterprises. The rejected enterprises were mainly micro-enterprises. The employed in chosen enterprises represent almost half the total industries and almost all the large enterprises.

The number of employed persons was received from three sources. Both the BR and the FSS include the average number of full-time workers. However, the population statistics use the number of employed at the end of the year[2]. This caused some difficulties, since during the recession year 1991, enterprises were forced to cut down quite a significant number of employees. Consequently, the unexceptional year of 1991 is not the best

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1 The compilation of the Financial Statement Statistics was extended to business services in 1990, which makes it impossible to have any relevant time series comparisons from the earlier years.

2 From the population statistics it is technically possible to specify the employer, for which the employee has been working the longest period of the year.

possible one for our purposes. The stratification of enterprises by employment size classes used in this study is based on the data from the Regional Employment Statistics.

Annex II

Figure 2.1
Personnel of technical services by age groups and sex, percentage

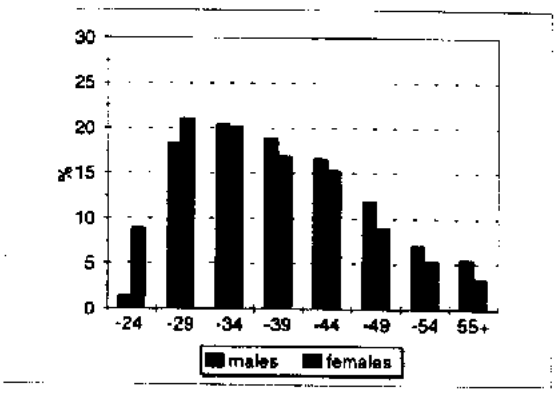


Figure 2.2
Personnel of computer services by age groups and sex, percentage

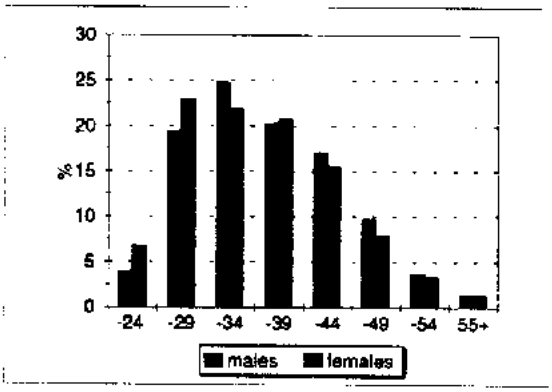
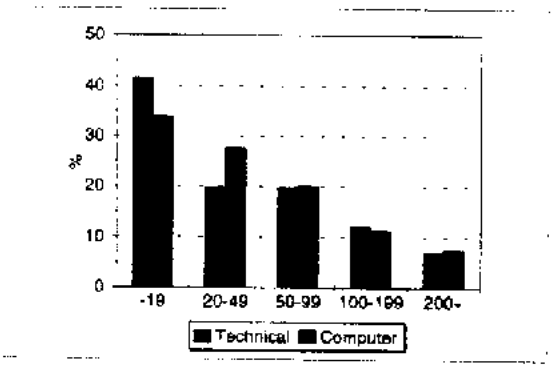


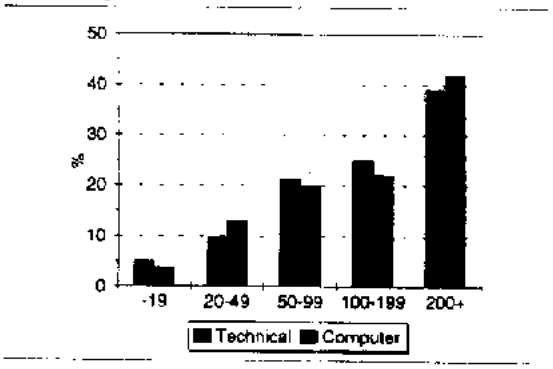
Figure 2.3
Enterprises by employment size class, percentage



Number of enterprises in study
Technical 142
Computer 80

Source: Statistics Finland

Figure 2.4
Personnel by employment size class of the enterprise, percentage



Number of persons employed in study
Technical 9256
Computer 5844

Annex III

Figure 3.1
Personnel in technical services in the Helsinki region by age groups and sex, percentage

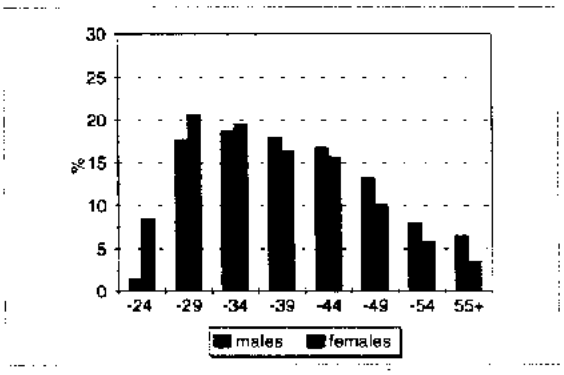


Figure 3.2
Personnel in computer services in the Helsinki region by age groups and sex, percentage

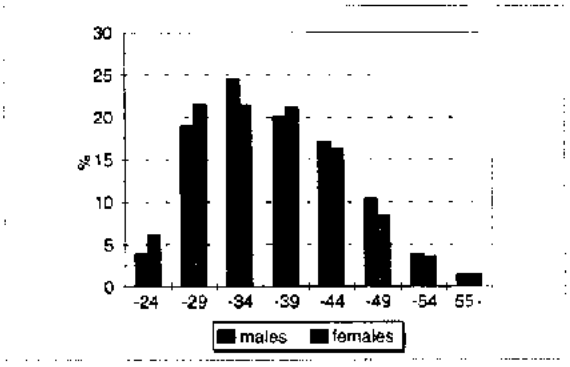


Figure 3.3
Personnel in technical services outside the Helsinki region by age groups and sex, percentage

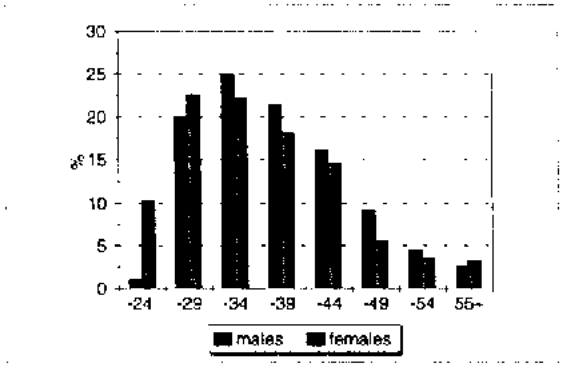


Figure 3.4
Personnel in computer services outside the Helsinki region by age groups and sex, percentage

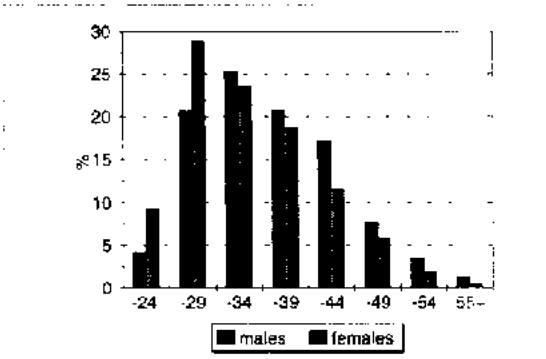
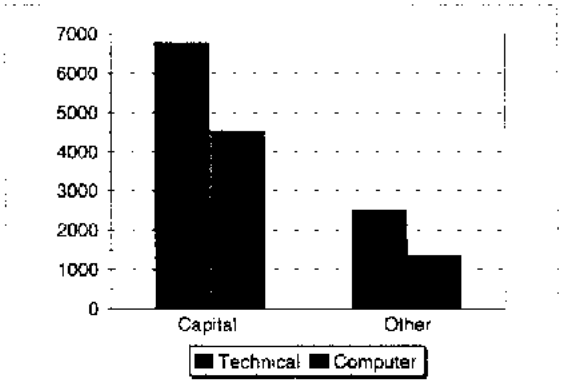


Figure 3.5
Number of persons employed in Helsinki region and other regions by activity



Number of persons employed in study

Technical	9256
Computer	5844

Source: Statistics Finland